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INTRODUCTION

Wildlife-aircraft collisions caused an estimated $114 million of damage annually to civilian aviation aircraft in the United States between 1993 and 1995 (Cleary et al. 1996). Significant damage to aircraft and crashes may result from the ingestion of one small bird (Cleary et al. 1996). Collisions that do not cause physical damage to aircraft often result in costs related to aircraft downtime while structural inspections are completed. Despite heightened awareness of the hazards wildlife present to aircraft, strikes occur often and occasionally have catastrophic results.

The yellow bittern (*Ixobrychus sinensis*) is a common breeding bird throughout the western Pacific. Yellow bittern threats to aviation safety have not been previously documented, but are presumably present at airfields throughout the tropical Pacific. Bitterns feed primarily on lizards and insects and forage in open grassy areas that are typical of most airfields. Bitterns are year-round residents on the island of Guam in the Mariana chain, and are the only native bird commonly breeding on the island. Bitterns are widely distributed throughout Guam and are abundant around the few remaining freshwater wetlands on the island. Bittern breeding occurs all year, although a peak in activity may occur between January and June (Jenkins 1983). Common nest sites on Guam include wetland vegetation, palm trees, ornamental shrubs, and ground nests in dense grass. Nests and foraging sites are often located miles from water. The birds are generally solitary, but are occasionally observed in loose flocks of 30 birds or more. This paper summarizes the activities and results of an on-going management program dealing with aviation hazards created by yellow bitterns on Guam.

PROGRAM BACKGROUND AND CHRONOLOGY

In October 1995, the superintendent of operations at A. B. Won Pat International Airport (Won Pat), Guam, requested the United States Department of Agriculture's Wildlife Services (WS) program provide some technical assistance regarding bird hazards to aircraft. In response to this request, a WS biologist conducted an initial hazard assessment at the airport. During the assessment, Pacific lesser golden plovers (*Pluvialis dominica fulva*), cattle egrets (*Bubulcus ibis*), and ruddy turnstones (*Arenaria interpres*) were identified as the primary species of concern regarding aviation safety. Yellow bitterns were observed foraging and loafing on the airfield, but were not present in large enough numbers to be considered a significant threat to aviation. No nesting bitterns were observed during this initial assessment.

WS began a seasonal (October-April) bird aircraft-strike hazard (BASH) management program at Won Pat in February, 1996. The operational control program initially addressed threats associated with flocks of migratory Pacific lesser golden plovers. Control methods employed at Won Pat included pyrotechnics, propane cannons, decoys, and vehicular harassment. Other birds, including bitterns, were also dispersed when encountered inside the Air Operations Area (AOA). In addition to dispersal responsibilities, WS employees conducted daily runway sweeps to detect unreported strikes (Linnell et al. 1996). WS also recommended the airport maintain the infield grass as short as possible.

In November 1996, WS personnel observed bitterns (n = 6) nesting in a 20 acre grassy area between Delta and Echo taxiways on the south side of the airfield. The birds were constructing nests in manicured grasses and forbs that did not appear to provide adequate cover for nesting and were often within visual

range of each other. During the next 5 months, up to 16 active nests were observed at one time in the same area of the infield. Individual nests (n = 8) were located at various locations around the infield, again in short grasses and forbs. In response to the nest initiations, WS employees began more intensive dispersal efforts aimed at bitterns. Despite increased harassment, nesting bittern numbers slowly increased on the airfield. Concurrent with the observed start of nesting activity by yellow bitterns at Won Pat, WS personnel began to discover dead yellow bitterns while performing daily runway sweeps (Table 1).

From November 1996 - April 1997, 9 bittern strikes were detected. None of these strikes were pilot-reported. At the beginning of the 1998 WS operational season (October 1, 1997), 13 active bittern nests were detected in the same grassy area between Delta and Echo taxiway. Over the next 2 months, bittern nesting activity continued to increase on the airfield, despite monthly mowing of the areas utilized by the nesting bitterns. In mid-December 1997, Guam was hit by Supertyphoon "Paka", which damaged much of the available bittern nesting habitat surrounding the airfield. Immediately following the storm, the number of active bittern nests on the airfield increased dramatically; up to 150 active nests were located on the airfield during mid-February. Bitterns began colonially nesting throughout the infield, in both mowed and unmowed areas. Again, a surge in bittern-aircraft strikes (n = 15 in February 1998) was documented concurrent with the increased nesting activity.

In an attempt to resolve the aviation hazards presented by bitterns at Won Pat, WS recommended an intensive management program aimed at reducing bittern nesting activity on the airfield. The primary management techniques recommended by WS were nest destruction and higher intensity grass mowing. After coordination with local wildlife officials, WS began destroying nests on January 26, 1998. Nest destruction continued throughout the end of the field season (Table 2). In addition to active nest destruction, WS recommended mowing frequency on the AOA increase from monthly to bi-monthly. While this recommendation was initially followed by airport management, some areas of the airfield were mowed as infrequently as every 2 months during the nesting season.

Following the end of the 1997-98 season, airport management agreed to maintain a bi-weekly mowing regime on the airfield. However, when WS began field work in October 1998, the mowing contractors had returned to a 7 cuttings-per year contract. Bittern nesting was occurring in the same primary locations as the previous season, and since mowing was occurring approximately every 8 weeks, individual nests were successfully hatching and fledging young. Again, WS recommended increased mowing frequency and nest removal to address the problem. WS began nest destruction on January 23, 1999, and continued through the end of the season (Table 2).

BITTERN POINT COUNTS

To assess the impacts of nest destruction on bittern use of the airfield, WS personnel established 6 permanent count stations around the AOA. Visual counts were conducted twice daily, once in the morning and once in the evening, for 10 minutes at each station. Morning counts began around 0630 and evening counts began around 1600. During each 10 minute count period, all visible bitterns on or over the airfield were counted. To avoid "roll-up" between count stations, each observer noted the location of any loafing bitterns. Count data is available for only one week prior to the initiation of nest destruction in 1997-98, and data is still being collected for the 1998-99 season; therefore no statistical analysis is presented for pre- and post-treatment comparisons. Data is presented as the mean number of bitterns counted at each site for both morning and evening surveys.

SURVEY RESULTS

Weekly mean abundance values for the 1997-98 season were highest at the onset of count activities (Figure 1), averaging nearly 44 individuals per morning count period. Mean weekly evening counts were lower than mean weekly morning counts throughout the season. The overall mean number of bitterns observed during morning counts was 12.4 (SE 3.88); the mean for evening counts was 6.29 (SE 2.32). Morning and evening

counts were not significantly different (t = 1.38, P = 0.18). Both morning and evening mean count values began dropping soon after the initiation of nest destruction and dropped below 10 birds per count period by late February. Mean count numbers remained consistently low through the end of the season.

Mean morning count values for the 1998-99 season were also highest during the initial count periods (Figure 2). Count numbers were again higher during morning counts than evening counts. The overall mean number of bitterns observed on morning counts was 14.96 (SE 1.35); the overall mean for evening counts was 7.36 (SE 0.68). Mean morning count values were significantly different than mean evening counts (t = 5.54, P = 0.0001) Unlike the previous year, mean count numbers did not show a steady decline through the season. However, by the end of February, bittern abundance on the airfield dropped to below 10 birds per count period, approaching the survey averages of the previous February.

DISCUSSION

Although yellow bitterns are relatively small birds (average adult weight is about 110 g), the frequency of strike occurrences and their loose flocking behavior make them a significant threat to aviation safety at Won Pat. Commercial arrivals and departures at Won Pat average approximately 800 per month. During the month of February, 1998, a bittern was struck by an aircraft approximately every 50 flights, including 2 multiple strike events. No strikes resulted in structural damage to aircraft, and only one incident was reported by the flight crew. Despite the lack of damage, the continued presence of large numbers of breeding birds at Won Pat warrants continued intensive management.

Our observations of bittern nesting behavior at Won Pat suggest nesting birds may quickly renest upon losing a clutch and may re-nest multiple times over the course of the nesting season. In fact, the highest nest numbers in both survey years were observed more than 30 days after nest destruction was implemented, suggesting the local breeding birds were actively renesting. Juvenile bitterns are able to leave the nest after about 14 days and probably receive parental care for a short time following fledging. The short period of parental care may allow a single female to raise multiple broods per nesting season.

Yellow bitterns do not respond to traditional wildlife harassment techniques (i.e., pyrotechnics, propane cannons) often used at airports. In addition, seasonal changes and catastrophic atmospheric events appear to significantly affect bittern abundance and nesting activity at Won Pat. Given the dynamic state of bittern activity at Won Pat, airport management may be able to minimize the aviation threat they present by maintaining a high intensity mowing regime during the entire year. During early January 1999, 20 nests on the airfield were observed before and after mowing operations. With the mower blade placed at the lowest possible setting, all 20 nests were either partially or completely destroyed. This suggests a mowing frequency of less than 21 days (the length of bittern incubation) should destroy all or nearly all nests occurring on the airfield.

However, bittern foraging activity may increase with increased mowing operations, since grass cutting results in injured insects and lizards, and may enhance foraging success of some birds (Fellows et al. 1987). Boluses recovered from juvenile bitterns and necropsies of bitterns recovered from the airfield at Won Pat indicate skinks (*Carlia* spp.) and geckos (*Hemidactylus frenatus* and *Lepidodactylus lugubris*) were the most frequently ingested prey items. These lizards are common in most habitats around Won Pat; *Carlia* spp. are especially abundant along manicured grass edges and roadways. For this reason, it is imperative to identify locations of highest nest densities and focus intensive mowing on these areas while maintaining a lower mowing intensity in preferred foraging locations.

Native bird populations on Guam are nearly absent, as a result of predation by the introduced brown treesnake (*Boiga irregularis*) (Savidge 1987, Engbring and Fritts 1988). Yellow bittern populations on Guam are an exception and have persisted in the presence of brown treesnakes. Several reasons may explain the relative abundance of bitterns on Guam. Bitterns tend to nest in habitats other than forested areas, where snakes densities are highest. In addition, bitterns are equipped with a heavy bill, which may provide some

measure of defense against marauding snakes. Adult bitterns are likely capable of killing and eating small snakes. However, despite their potential defenses, it is probable the snake has adversely impacted bittern recruitment. The largest number of breeding bitterns on Guam are generally found in areas of reduced snake densities, such as off-shore islets and urban areas.

The wide distribution of yellow bitterns throughout the Pacific suggests the birds are adept at colonizing new locations. Recent range expansions by yellow bitterns have been reported by Watson (1980) and Landsdown (1987). The rapid bittern colonization at Won Pat may be an indirect consequence of intensive brown treesnake removal from the jungle areas surrounding Won Pat over the past 6 years (Vice and Vice, unpub. manuscript). Semi-colonial nesting behavior exhibited by Won Pat bitterns has been previously observed on off-shore islets surrounding Guam and by Uchida and Matsuda (1992) in Japan. Nesting birds, particularly waterfowl, are known to quickly colonize areas devoid of predators (i.e., man-made islands). The substantial reductions in brown treesnake populations around Won Pat may have created an "island" of refuge for nesting birds. Increasing bird populations, including Philippine turtle dove (*Streptopelia bitroquata*), Eurasian tree sparrow (*Passer montanus*), and white tern (*Gygus alba*), observed in and around Won Pat over the past several years, may be a result of this control effort (G. Wiles, Guam Department of Agriculture, personal communication).

Future Needs

The management strategies for yellow bitterns at Won Pat are based on very limited ecological information gathered on Guam (Jenkins 1983, Engbring and Fritts 1988). Although some information on breeding and foraging is available from other Pacific locations (e. g., Landsdown and Rajanathan 1993, Ueda 1992, Uchida and Matsuda 1992), there is no available information on the management of bittern populations in a damage-causing situation.

Documented strikes at Won Pat have involved about half juvenile and half adult birds. It is not clear if the juvenile birds were locally recruited or were transients on the airfield. Similarly, it is not known if the adult birds struck were breeding birds or transients. Egg destruction targets only breeding birds, and mowing may enhance the efficiency of foraging birds. In addition, egg destruction may result in greater bittern activity, as nesting birds search for re-nesting sites. This may lead to increased strike rates and a subsequent increase in threats to aviation safety. Therefore, it is critical to characterize the target population in order to maximize the effectiveness of future control efforts, and active nest destruction should only implemented when other methods (i. e., increased mowing frequency) do not produce the desired results.

The results of the WS control program at Won Pat suggest habitat manipulations, such as increased grass mowing, in conjunction with nest destruction, can provide acceptable means of discouraging bitterns from nesting in a tropical airport environment. The seasonal problems presented by yellow bitterns at Won Pat have been moderated using a combination of these control methods; however, continued management of this population requires more information on habits, habitat use, and movements of bitterns on and around the Won Pat AOA.

Literature cited

Cleary, E. C., S. E. Wright, and R. A. Dolbeer. 1996. Wildlife strikes to civilian aircraft in the United States 1993-1995. U. S. Dept. Transp., Fed. Aviation Admin. Serial Rept. No. 2. Wash. D.C. 33 pp.

Engbring, J. and T. H. Fritts. 1988. Demise of an insular avifauna: the brown tree snake on Guam. Transactions of the western section of the Wildlife Society 24:31-37.

Fellows, D. P., P. W. C. Paton, L. F. Pank, and P. Q. Tomich. 1987. Cattle egret ecology, behavior, and control at General Lyman Field, Hilo, Hawaii. Bird Damage Research Report No. 391. Denver Wildlife Research Center, USDA-APHIS-ADC. 90 pp.

Jenkins, J. M. 1983. The native forest birds of Guam. Ornithological Monographs No. 31. 61pp.

Lansdown, R. V. 1987. Recent extension in breeding range of the yellow bittern *(Ixobrychus sinensis*). Forktail 3:61-63.

Lansdown, R. V. and R. Rajanathan. 1993. Some aspects of the ecology of *Ixobrychus* bitterns nesting in Malaysia rice fields. Colonial Waterbirds 16:98-101.

Linnell, M. A., M. R. Conover, and T. J. Ohashi. 1996. Analysis of birdstrikes at a tropical airport. J. Wildl. Manage. 60:935-945.

Savidge, J. A. 1987. Extinction of an island forest avifauna by an introduced snake. Ecology 68:660-668.

Ueda, K. 1992. Food of the yellow bittern (*Ixobrychus sinensis*) in boluses regurgitated by nestlings. J. Yamashina Inst. Ornithol. 24:13-17.

Uchida, H. and T. Matsuda. 1992. Colonial breeding of the yellow bittern (*Ixobrychus sinensis*). Japan J. Ornithol. 39:53-61.

Vice, D. S. and D. L. Vice. 1999. Nesting success and the development of semi-colonial nesting by yellow bitterns (*Ixobrychus sinensis*) on Guam. Unpub. manus.

Watson, J. 1980. Distribution and nesting of the yellow bittern in Seychelles. Ostrich 51:120-122.

Table 1. Yellow bittern strikes, by month, at Won Pat International Airport, Guam, 1996-1999

Month	1996-97	1997-98	1998-99
Oct	0	0	2
Nov	0	1	1
Dec	3	4	0
Jan	1	3	0
Feb	1	15	1
Mar	3	2	3
Apr	1	3	2

Table 2. Yellow bittern nests removed, by month, at Won Pat International Airport, Guam, 1998-99.

Month	1997-98	1998-99
Oct	0	0
Nov	0	0
Dec	0	0
Jan	82	53
Feb	157	51
Mar	66	208
Apr	34	50